

## CLAIMS

### WHAT IS CLAIMED IS:

- 1           1. An optical amplifier comprising:  
2                 a device substrate;  
3                 a first waveguide embedded in the device substrate; and  
4                 a first plurality of lasers positioned to provide a first plurality of light beams  
5                 substantially transverse to the first waveguide.
- 1           2. The optical amplifier of claim 1 wherein each of the first plurality of lasers are  
2 spaced apart from one another along a length of the first waveguide.
- 1           3. The optical amplifier of claim 2 wherein the first plurality of lasers are vertical  
2 cavity surface emitting lasers.
- 1           4. The optical amplifier of claim 3 wherein the first plurality of lasers share a  
2 common substrate.
- 1           5. The optical amplifier of claim 4 wherein the vertical cavity surface emitting  
2 lasers are bonded to the device substrate.
- 1           6. The optical amplifier of claim 1 wherein the device substrate is a phosphate  
2 glass doped with Erbium.

1           7. The optical amplifier of claim 1 further comprising:  
 2                 a second waveguide embedded in the device substrate; and  
 3                 a second plurality of lasers positioned to provide a second plurality of light  
 4                 beams substantially transverse to the second waveguide.

1           8. The optical amplifier of claim 1, wherein the first plurality of lasers are evenly  
 2 spaced apart from one another.

1           9. A method of amplifying an optical signal comprising:  
 2                 directing the optical signal through a waveguide, the optical signal having a  
 3                 first direction of propagation; and  
 4                 applying a plurality of light beams substantially transverse to the first  
 5                 direction of propagation.

1           10. The method of claim 9, wherein the plurality of light beams is provided by a  
 2 plurality of laser diodes.

1           11. The method of claim 10, wherein the optical signal has a wavelength of  
 2 approximately 1550 nm, and the plurality of light beams has a wavelength of  
 3 approximately 980 nm.

1           12. The method of claim 11, wherein the applying the plurality of light beams  
2 further comprises:  
3           using a plurality of lasers each using less than 50 mW of power.

1           13. The method of claim 11, wherein the applying the plurality of light beams  
2 further comprises:  
3           using a plurality of lasers each using less than 20 mW of power.

1           14. The method of claim 9 further comprising:  
2           reflecting the plurality of light beams back at the waveguide after passing  
3           through the waveguide.

1           15. A method of making an optical signal amplifier comprising:  
2           attaching a plurality of light sources to a surface of a substrate, the substrate  
3           having a waveguide embedded within, wherein the plurality of light  
4           sources are directed substantially transverse to the waveguide.

1           16. The method of claim 15, wherein the attaching of the plurality of light sources  
2 comprises:  
3           bonding a plurality of vertical cavity surface emitting lasers to the surface of  
4           the substrate.

1 17. The method of claim 16, wherein each of the plurality of vertical cavity  
2 surface emitting lasers is spaced apart in a line on a common semiconductor substrate.

1 18. The method of claim 16, wherein each of the plurality of vertical cavity  
2 surface emitting lasers is spaced apart by a constant distance.

1 19. The method of claim 16, wherein the plurality of vertical cavity surface  
2 emitting lasers each operate at less than 50 mW.

1 20. The method of claim 16, wherein the plurality of vertical cavity surface  
2 emitting lasers each operate at less than 20 mW.

1 21. An optical amplifier comprising:  
2 a substrate;  
3 a waveguide embedded within the substrate, the waveguide having a primary  
4 direction of propagation;  
5 an array of lasers positioned to provide a plurality of pumped light beams  
6 transverse to the primary direction of propagation.

1 22. The optical amplifier of claim 21, wherein at least one of the array of lasers  
2 operates at less than 20 mW of power.